

Terahertz Phase Shifters for Electronic Steering of Radars and Radiometers

Completed Technology Project (2017 - 2019)



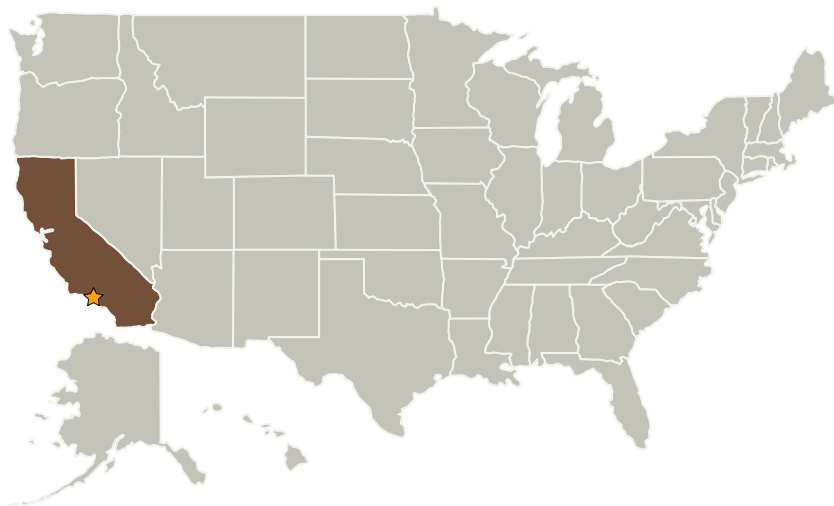
Project Introduction

Design a low-loss ($<1\text{dB}$) phase shifter compatible with a phased-array architecture at 560GHz .
 Fabricate phase shifter using silicon deep reactive ion etching.
 Demonstrate single phase shifter with low-loss ($<1\text{dB}$) and 180° of phase-shift.

Anticipated Benefits

Need: Increase the science return of an instrument by reducing or eliminating spacecraft pointing. Faster pointing of the instrument to enable mapping. Lower power consumption compared to mechanical scanning. Potential applications include Mars wind measurements, Microwave-limb sounder follow-on, Comet radar and Mapping radiometer/spectrometer for Icy bodies.

Primary U.S. Work Locations and Key Partners



| Organizations Performing Work | Role | Type | Location |
|-----------------------------------|-------------------|-------------|----------------------|
| ★ Jet Propulsion Laboratory (JPL) | Lead Organization | NASA Center | Pasadena, California |

Primary U.S. Work Locations

California



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Project Transitions

**October 2017:** Project Start**September 2019:** Closed out

Closeout Summary: Submillimeter-wave spectrometer and radar instruments provide essential information for remotely studying atmospheric composition, measuring the surface properties of cold bodies and the understanding of interstellar formation and dynamics. All of these instruments require high power and bulky mechanical systems to scan the beam and perform the observation, due to a lack of phased arrays at these frequencies. This project leveraged existing MEMS technology developed at JPL to develop a low-loss phase shifter, applicable to electronic beam steering at 200GHz and beyond. By using a large-deflection MEMS actuator to load a waveguide with dielectric, the phase can be controlled with minimal losses at frequencies above where most active devices can operate (e.g. SiGe integrated circuits). The phase shifters and phased array antenna geometries developed on this task will enable an integrated low-power and low-volume beam scanning systems at submillimeter-wave frequencies for spectrometers and radars. The next step will be to integrate these capabilities into an instrument concept.

Project Website:

https://www.nasa.gov/directorates/spacetech/innovation_fund/index.html#.VC

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Jet Propulsion Laboratory (JPL)

Responsible Program:

Center Innovation Fund: JPL CIF

Project Management

Program Director:

Michael R Lapointe

Program Manager:

Fred Y Hadaegh

Principal Investigator:

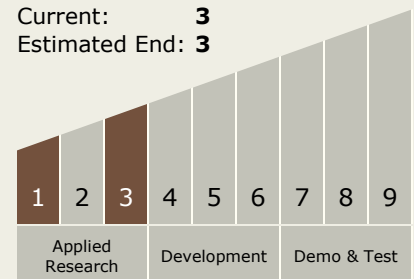
Maria Alonso

Co-Investigator:

Cecile Jung-kubiak

Technology Maturity (TRL)

Start: 1
Current: 3
Estimated End: 3



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Technology Areas

Primary:

- TX14 Thermal Management Systems
 - └ TX14.1 Cryogenic Systems
 - └ TX14.1.3 Thermal Conditioning for Sensors, Instruments, and High Efficiency Electric Motors

Target Destinations

Earth, Mars, Others Inside the Solar System